

1 CLAIMS:

2 We claim:

3 1. A method comprising generating a Concrete Model, said Concrete Model describing a  
4 structure of resources implementable over a computing utility infrastructure, and satisfying a set  
5 of service requirements, said step of generating comprising the steps of:

6 obtaining a Service Environment Model of a service environment, said Service  
7 Environment Model describing a set of requirements on a new desired state of said  
8 service environment;

9 getting an Infrastructure Model describing both resources and an organization of the  
10 resources in the computing utility infrastructure, said Infrastructure Model is encapsulated  
11 in a knowledge subsystem; and

12 forming the Concrete Model describing a resource structure such that said Concrete  
13 Model refines the Service Environment Model and is mappable to said knowledge  
14 subsystem .

15 2. A method as recited in claim 1, wherein the step of obtaining a Service Environment Model of  
16 the service environment includes receiving a description of a set of requirements on a new  
17 desired state of said service environment.

18 3. A method as recited in claim 1, wherein said Service Environment Model description is  
19 independent of the computing utility infrastructure;

20 4. A method as recited in claim 1, wherein said service environment is an entity taken from a  
21 group of entities consisting of: a Web site, an on-line gaming service, a scientific computation  
22 service, an e-business service, a computing service, and any combination of these.

1 5. An article of manufacture comprising a computer usable medium having computer readable  
2 program code means embodied therein for causing generation of a Concrete Model, the computer  
3 readable program code means in said article of manufacture comprising computer readable  
4 program code means for causing a computer to effect the steps of claim 1.

5 6. A method as recited in claim 1, wherein the step of getting an Infrastructure Model includes  
6 an action taken from a group of actions consisting of: querying at least one knowledge subsystem  
7 entity; querying Resource Managers, querying Resource Instance Services, querying a best  
8 practices catalog; obtaining knowledge of available resource types; obtaining knowledge of  
9 resources constraints; obtaining knowledge of resource capabilities; obtaining knowledge of  
10 infrastructure constraints; obtaining knowledge of infrastructure capabilities; obtaining  
11 knowledge of infrastructure best practices patterns; and any combination of these actions.

12 7. A method as recited in claim 1, wherein the step of forming a Concrete Model includes:  
13 at least one refinement step comprised of selecting a node and replacing said node with a  
14 sub graph structure to obtain an intermediary model which is an input to a next refinement step;  
15 repeating the step of selecting and replacing until a resulting intermediary model is  
16 mappable to said knowledge subsystem.

17 8. A method as recited in claim 7, wherein said step of replacing comprises a limitation taken  
18 from a group of limitations consisting of: querying a best practices catalog; generating sub graph  
19 patterns dynamically; employing graph matching techniques to obtain said sub-graph structure;  
20 employing graph merging techniques to obtain said sub-graph structure; any combination of  
21 these limitations.

22 9. A program storage device readable by machine, tangibly embodying a program of instructions  
23 executable by the machine to perform method steps for generating a Concrete Model, said  
24 method steps comprising the steps of claim 1.

1 10. A method as recited in claim 1, further comprising using said generating said Concrete  
2 Model to enforce a policy based service provider's best practices in implementation of Service  
3 Environments in the computing utility infrastructure.

4 11. A method as recited in claim 10, wherein the best practices are encoded as patterns in a best  
5 practices catalog and used in the step of forming said Concrete Model.

6 12. A method as recited in claim 1, further comprising employing said Concrete Model to  
7 generate provisioning actions, said provisioning actions, when executed, create a resource  
8 structure that matches the description in the Concrete Model, said resource structure satisfies said  
9 set of requirements on new desired state of said service environment.

10 13. A method as recited in claim 12, further comprising employing said provisioning to enforce  
11 a policy based service provider's best practices in implementation of service environments in the  
12 computing utility infrastructure.

13 14. A method as recited in claim 13, wherein the best practices are encoded as patterns in a best  
14 practices catalog and used in the step of forming the Concrete Model.

15 15. A method as recited in claim 12, wherein step of provisioning includes a task taken from a  
16 group of tasks consisting of: creating a new service environment, changing the combination of  
17 resources allocated to a service environment, changing the configuration of resources allocated to  
18 a service environment, or destroying a service environment, or any combination of the above.

19 16. A method as recited in claim 15, wherein changing the configuration of resources allocated  
20 to a service environment include changing the local state of a resource or changing the way the  
21 resource is configured to work with other resources.

22 17. A method as recited in claim 1, wherein the method can be used to regenerate provisioning  
23 instructions whenever at least one of the following occurs: infrastructure characteristics change,

1 and requirements of a service change.

2 18. A method as recited in claim 17, wherein the infrastructure characteristics include a  
3 characteristic taken from a group of characteristics consisting of: types of resources in the  
4 infrastructure, capabilities of said resources, configuration of said resources, constraints on  
5 configuration of said resources, best practices patterns as defined in the best practices catalog,  
6 and any combination of the above.

7 19. A method as recited in claim 1, further comprising employing said Concrete Model to  
8 generate a Resource Manager for a composite resource.

9 20. A method as recited in claim 19, wherein said Resource Manager provides a set of resource  
10 manager methods taken from a group of resource manager methods consisting of: creating  
11 composite resources based on a Concrete Model, changing composite resources based on a  
12 Concrete Model, destroying composite resources based on a Concrete Model, and any  
13 combination of these methods.

14 21. An apparatus comprising means for generating a Concrete Model, said Concrete Model  
15 describing a structure of resources implementable over a computing utility infrastructure, and  
16 satisfying a set of service requirements, said step of generating comprising the steps of:

17 means for obtaining a Service Environment Model of a service environment, said Service  
18 Environment Model describing a new desired state of said service environment;

19 means for getting an Infrastructure Model describing both resources and an organization  
20 of the resources in the computing utility infrastructure, said Infrastructure Model is  
21 encapsulated in a knowledge subsystem and

22 means for forming the Concrete Model describing a resource structure such that said  
23 Concrete Model refines the Service Environment Model and is mappable to said

1           knowledge subsystem .

2       22. An apparatus as recited in claim 21, further comprising means for employing said Concrete  
3       Model to generate provisioning actions, said provisioning actions, when executed, create a  
4       resource structure that matches the description in the Concrete Model, said resource structure  
5       satisfies said new desired state of said service environment.

6       23. A computer program product comprising a computer usable medium having computer  
7       readable program code means embodied therein for causing generation a Concrete Model, the  
8       computer readable program code means in said computer program product comprising computer  
9       readable program code means for causing a computer to effect the functions of claim 21.

10      24. An apparatus as recited in claim 21, further comprising means for employing said Concrete  
11      Model to generate a Resource Manager for a composite resource.

12      25. A method as recited in claim 1, where the step of generating a Concrete Model is performed  
13      by a user taken from a group of user's consisting of: a service provider, a customer of a service  
14      provider, a company owning an IT infrastructure, and a utility provider.